BAYOU DES ALLEMANDS TMDLS FOR DISSOLVED OXYGEN AND NUTRIENTS

FINAL
March 25, 2005

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FOR DISSOLVED OXYGEN AND NUTRIENTS

SUBSEGMENT 020201

Prepared for

US EPA Region 6
Water Quality Protection Division
Permits, Oversight, and TMDL Team

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EXECUTIVE SUMMARY

Section 303(d) of the Federal Clean Water Act requires states to identify waterbodies that are not meeting water quality standards and to develop total maximum daily pollutant loads for those waterbodies. A total maximum daily load (TMDL) is the amount of pollutant that a waterbody can assimilate without exceeding the established water quality standard for that pollutant. Through a TMDL, pollutant loads can be distributed or allocated to point sources and nonpoint sources (NPS) discharging to the waterbody. This report presents TMDLs that have been developed for dissolved oxygen (DO) and nutrients for Bayou des Allemands (subsegment 020201) in the Barataria basin in southern Louisiana.

Bayou des Allemands is located southwest of New Orleans, LA in the Barataria basin. The bayou has a total drainage area of 759 mi^2. Most of the Bayou des Allemands subsegment is marsh, sparsely populated, with minimal agricultural use.

Subsegment 020201 was listed on the Modified Court Ordered 303(d) List for Louisiana as not fully supporting the designated use of propagation of fish and wildlife and was ranked as priority #3 for TMDL development. The causes for impairment cited in the 303(d) List included organic enrichment/low DO and nutrients. The water quality standard for DO in this subsegment is 5 mg/L year round.

A water quality model (QUAL-TX) was set up to simulate DO, carbonaceous biochemical oxygen demand (CBOD), nutrients, and algae in the subsegment. The model was set up and calibrated using intensive survey data collected for this subsegment in August 2002. Model verification was then performed by using the calibrated model to simulate conditions during a different time period (July 2003) without adjusting model calibration parameters. The model predictions for the verification were similar to the observed data from the July 2003 survey, especially considering that the two surveys were nearly a year apart. Then, in order to develop the most accurate and robust model using all available data, the calibration was adjusted slightly to develop a single set of calibration parameter values that yielded the best match between predicted and observed data for both data sets. The projection simulation was run at critical flows and temperatures to address seasonality as required by the Clean Water Act.

Reductions of existing NPS loads were required for the projection simulation to show the DO standard of 5 mg/L being maintained. In general, the modeling in this study was consistent with guidance in the Louisiana TMDL Technical Procedures Manual.

TMDLs for oxygen demanding substances and nutrients (CBOD, ammonia nitrogen, organic nitrogen, nitrate nitrogen, and phosphorus) were calculated using the results of the projection simulation. In addition to the implicit margin of safety (MOS) that was established through conservative assumptions in the modeling, an explicit MOS of 10% and a future growth allowance of 10% were both included in the TMDL calculations. The results of the modeling and TMDL calculations showed that NPS loads will need to be reduced by approximately 75% to meet the DO standard of 5 mg/L in subsegment 020201. Oxygen demand from point sources in this subsegment was very small; therefore, the modeling assumed no changes to existing permit limits for point source discharges. The results of the TMDL calculations are summarized in Table ES.1.

Table ES.1. DO and nutrient TMDLs for subsegment 020201 (Bayou des Allemands).

	Loads (kg/day)				
	CBODu	Organic N	Ammonia N	NO2+NO3 N	Phosphorus
Point source wasteload allocation (WLA)	2.86	0.21	0.42	0.42	0.21
Nonpoint source load allocation (LA)	8298.66	2926.82	348.97	92.62	258.94
Explicit Margin of Safety (10%)	1037.69	365.88	43.67	11.63	32.40
Future Growth (10%)	1037.69	365.87	43.67	11.63	32.39
Total maximum daily load (TMDL)	10376.90	3658.78	436.73	116.30	323.94

Much of coastal Louisiana was built by the process of delta formation through flooding and deposition of sediments by the rise and fall of the Mississippi River. Based on EPA’s present knowledge, extensive areas of wetlands and coastal marshes are affected by a high rate of subsidence and degradation, primarily due to a lack of historical sediment and nutrients entering the wetlands. Subsidence is a natural process, but the building of levee systems has restricted the Mississippi River’s course therefore preventing the natural cycle of the river and the natural process of delta formation. According to EPA, a large portion of the state’s coastal wetlands have undergone and continue to undergo a severe deprivation of sediments and nutrients that has led quite literally to the breakup of the natural system. In addition, EPA believes that many of Louisiana's wetlands have become isolated from the riverine sources that created them and are becoming stagnant and starved for nutrients and organic and inorganic sediments. It should be pointed out that restoration of these eroding wetlands involves supplying nutrients to these wetlands through managed Mississippi River diversions.

The proposed TMDLs for DO and nutrients for Bayou des Allemands do not include any known diversion projects from the Mississippi River or other tributaries at this time. However, any future reintroduction under the Louisiana Coastal Area Restoration projects could increase the flow in Bayou des Allemands. EPA believes that flows greater than the critical flows used in the TMDLs will enhance DO and decrease the likelihood of instream nutrient impairment in Bayou des Allemands. Based on EPA's understanding, if any future diversion from the Mississippi River or other tributaries into Bayou des Allemands increases flow, the nonpoint source load allocation and TMDL will also be increased proportionately.

Based on EPA's current understanding, the diversion projects are supported by both State and Federal agencies, including EPA and the U.S. Army Corps of Engineers. The diversions are managed by the Corps of Engineers and the State, and the projects include post-diversion monitoring to determine effectiveness of the project and to monitor water quality conditions.

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1.0 INTRODUCTION

This report presents total maximum daily loads (TMDLs) for dissolved oxygen (DO) and nutrients for subsegment 020201, which includes Bayou des Allemands from Lac des Allemands to Highway 90. This subsegment was listed on the 2000 Modified Court Ordered 303(d) List for Louisiana (EPA 2000) as not fully supporting the designated use of propagation of fish and wildlife and was ranked as priority #3 for TMDL development. The suspected sources and suspected causes for impairment in the 303(d) List are included in Table 1.1. The TMDLs in this report were developed in accordance with Section 303(d) of the Federal Clean Water Act and EPA's regulations in 40 CFR 130.7. The 303(d) Listings for other pollutants in this subsegment are being addressed by EPA and the Louisiana Department of Environmental Quality (LDEQ) in other documents.

The purpose of a TMDL is to determine the pollutant loading that a waterbody can assimilate without exceeding the water quality standard for that pollutant and to establish the load reduction that is necessary to meet the standard in a waterbody. The TMDL is the sum of the wasteload allocation (WLA), the load allocation (LA), and a margin of safety (MOS). The WLA is the load allocated to point sources of the pollutant of concern, and the LA is the load allocated to nonpoint sources (NPS). The MOS is a percentage of the TMDL that accounts for the uncertainty associated with the model assumptions and data inadequacies.

Table 1.1. Summary of 303(d) Listing of subsegment 020201 (EPA 2000).

Subsegment Number	Waterbody Description	Suspected Sources	Suspected Causes	Priority Ranking (1 = highest)
020201	Bayou des Allemands - Lac des Allemands to U.S. Hwy. 90 (scenic)	Industrial point sources Minor industrial point sources Other Sediment resuspension Upstream sources Unknown source	Mercury Organic enrichment/low DO Turbidity Nutrients Oil & Grease Suspended solids Salinity/TDS/chlorides/sulfates Noxious aquatic plants Pesticides	3

2.0 STUDY AREA DESCRIPTION

2.1 General Information

Bayou des Allemands (subsegment 020201) is located approximately 25 mi (40 km) southwest of New Orleans, LA in the Barataria basin (see Figure 2.1). Bayou des Allemands begins at the southern end of Lac des Allemands and flows generally southeast until it ends at Lake Salvador. The bayou has a drainage area of 759 mi^2 at its mouth (USGS 1971). Subsegment 020201 includes Bayou des Allemands from Lac des Allemands to Highway 90 at Des Allemands, LA (a length of 7.1 mi).and has a total area of 40 mi^2 (103.5 km^2). This subsegment is tidally influenced because of its proximity to the Gulf of Mexico and its low gradient. During low flow conditions, water can flow in either direction in Bayou des Allemands depending on tides and wind conditions. After storms, though, the runoff from the large upstream drainage area tends to maintain a positive flow (i.e., towards the Gulf) in the bayou.

Land use for subsegment 020201 is shown graphically in Figure 2.2 and is tabulated in Table 2.1. The primary land uses in the Bayou des Allemands subsegment are freshwater marsh and wetland forest.

Table 2.1. Land uses in subsegment 020201 based on GAP data (USGS 1998).

Land Use Type	% of Total Area
Fresh Water Marsh	54.8%
Saline Marsh	0.0%
Wetland Forest	24.2%
Upland Forest	0.1%
Wetland Scrub/Shrub	2.6%
Upland Scrub/Shrub	0.2%
Agricultural	5.8%
Urban	0.4%
Water	11.9%
Barren Land	0.0%
TOTAL	100.0%

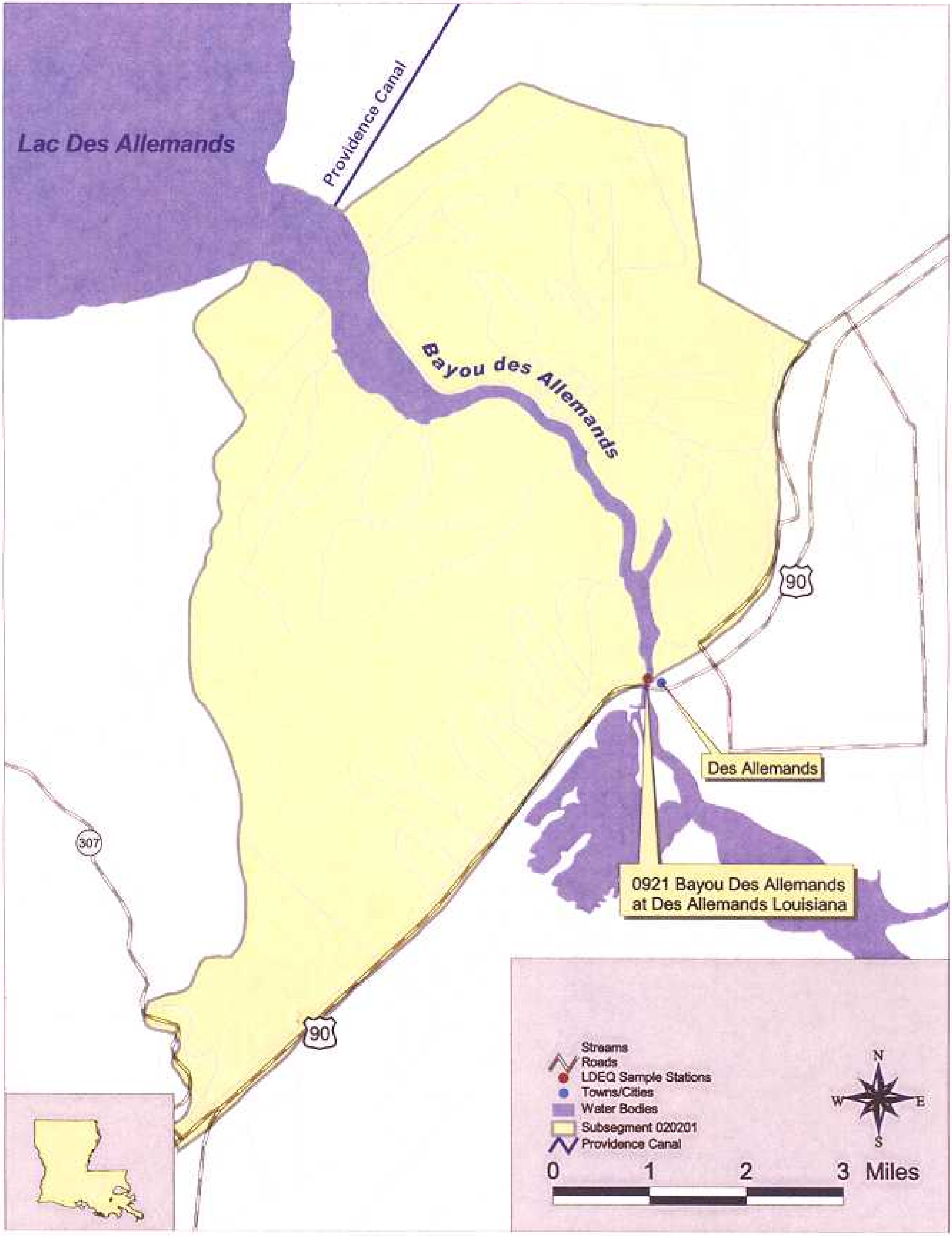

Figure 2.1. Subsegment map for Bayou des Allemands (020201).

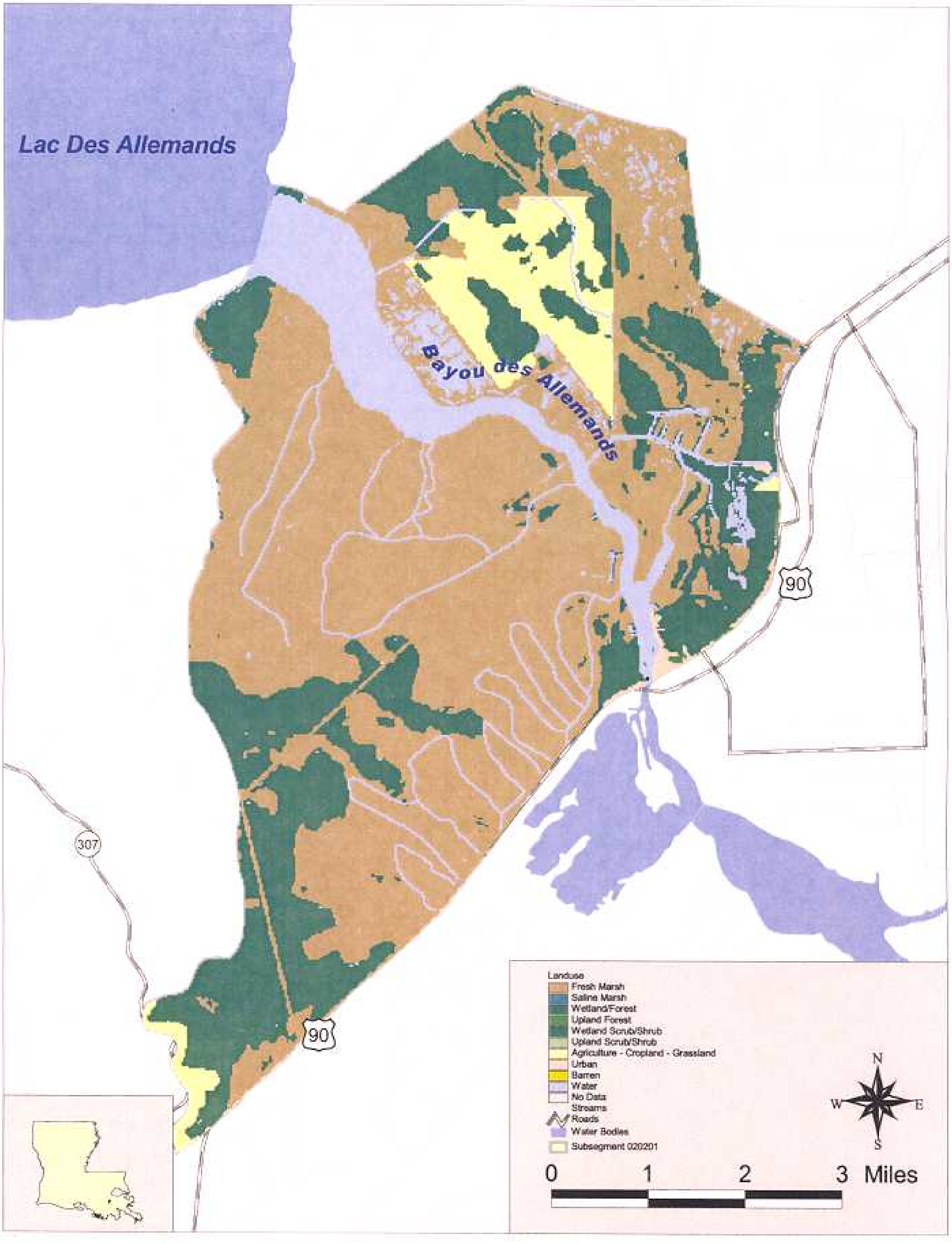

Figure 2.2. Landuse map for subsegment 020201 (Bayou des Allemands).

2.2 Designated Uses and Water Quality Standards

The numeric water quality standards and designated uses for this subsegment are shown in Table 2.2. Bayou des Allemands is designated as an outstanding natural resource water. The primary numeric standard for the TMDLs presented in this report is the DO standard of 5 mg/L year round.

Table 2.2. Water quality standards and designated uses (LDEQ 2003a).

Subsegment Number	020201
Waterbody Description	Bayou des Allemands – Lac Des Allemands to Hwy. U.S. 90 (scenic)
Designated Uses	ABCG
Criteria:	
Chloride	600 mg/L
Sulfate	100 mg/L
DO	5 mg/L (year round)
pH	6.0-8.5
Temperature	32^{o}C
TDS	1320 mg/L

USES: A – primary contact recreation; B – secondary contact recreation; C – propagation of fish and wildlife; D – drinking water supply; E – oyster propagation; F – agriculture; G – outstanding natural resource water; L – limited aquatic life and wildlife use.

Louisiana does not have numeric water quality standards for nutrients, but Louisiana's narrative standard for nutrients states that:

- The naturally occurring range of nitrogen-phosphorus ratios shall be maintained (except for intermittent streams), and
- Nutrient concentrations that produce aquatic growth to the extent that it creates a public nuisance or interferes with designated water uses shall not be added to any surface waters.

The Louisiana water quality standards also include an antidegradation policy (LAC 33: IX.1109.A). This policy states that state waters exhibiting high water quality should be maintained at that high level of water quality. If this is not possible, water quality of a level that supports the designated uses of the waterbody should be maintained. Changing the designated uses of a waterbody to allow a lower level of water quality can only be achieved through a use attainability study.

2.3 Point Sources

A listing of NPDES permits in the Barataria and Terrebonne basins in Louisiana was prepared by EPA Region 6 using databases and permit files from LDEQ. This list was used to identify NPDES permitted dischargers within the Bayou des Allemands subsegment (020201). Based on this listing, three NPDES permits were identified within subsegment 020201 and are shown in Appendix A. Only one of these point sources was included in the model; the others are small discharges and distant from the modeled waterbody (Bayou des Allemands).

2.4 Nonpoint Sources

Suspected nonpoint sources for subsegment 020201 have been listed in the February 29, 2000 Modified Court Ordered 303(d) List for Louisiana (EPA 2000). These sources include sediment resuspension, upstream sources, and unknown sources. Based on LDEQ's experience in the Barataria basin, it is suspected that there is considerable nonpoint oxygen demand in this subsegment that is natural (i.e., not induced by human activities).

2.5 Historical Data

One USGS water quality monitoring station (station #07380300 , "Bayou Des Allemads at Des Allemands") was found but DO data had not been collected at the station. There were two LDEQ ambient water quality monitoring stations on Bayou Des Allemands, but only one in this subsegment (0292 Bayou des Allemands at des Allemands, Louisiana). DO values below the water quality standard have been recorded at both stations. The DO data from station 0292 are shown in Figures 2.3 and 2.4. Figure 2.3 shows that most of the DO values below the standard occurred in the summer months while Figure 2.4 shows that most of the DO values below the standard occurred in 2000.

2.6 Previous Studies

No previous water quality studies have been identified for subsegment 020201. There are no US Geological Survey (USGS) or Corps of Engineers flow gages in the subsegment. The only historical water quality data that are known to exist are the LDEQ data mentioned in Section 2.5.

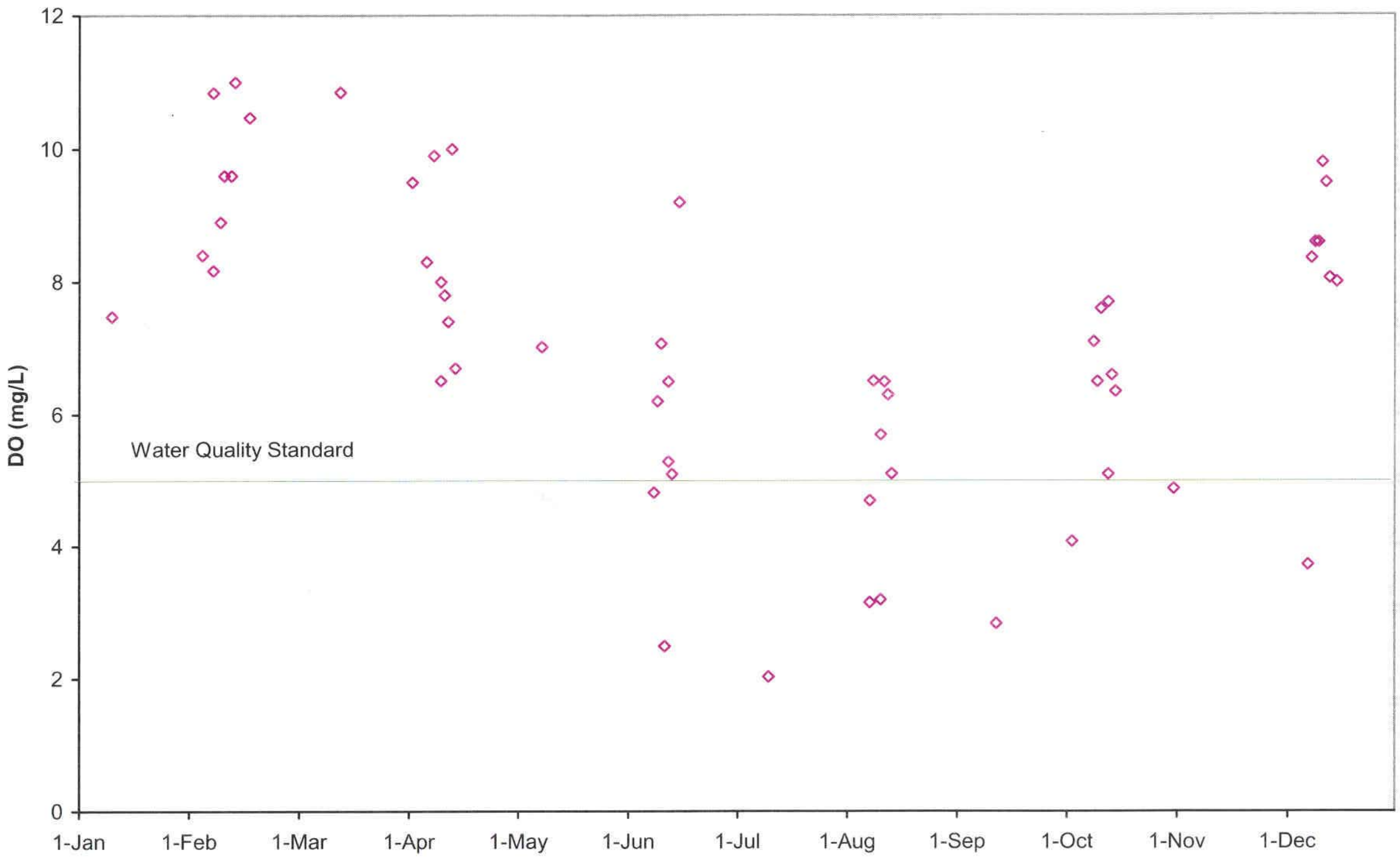

Figure 2.3. Seasonal water quality for Bayou des Allemands (LDEQ Station 0292).

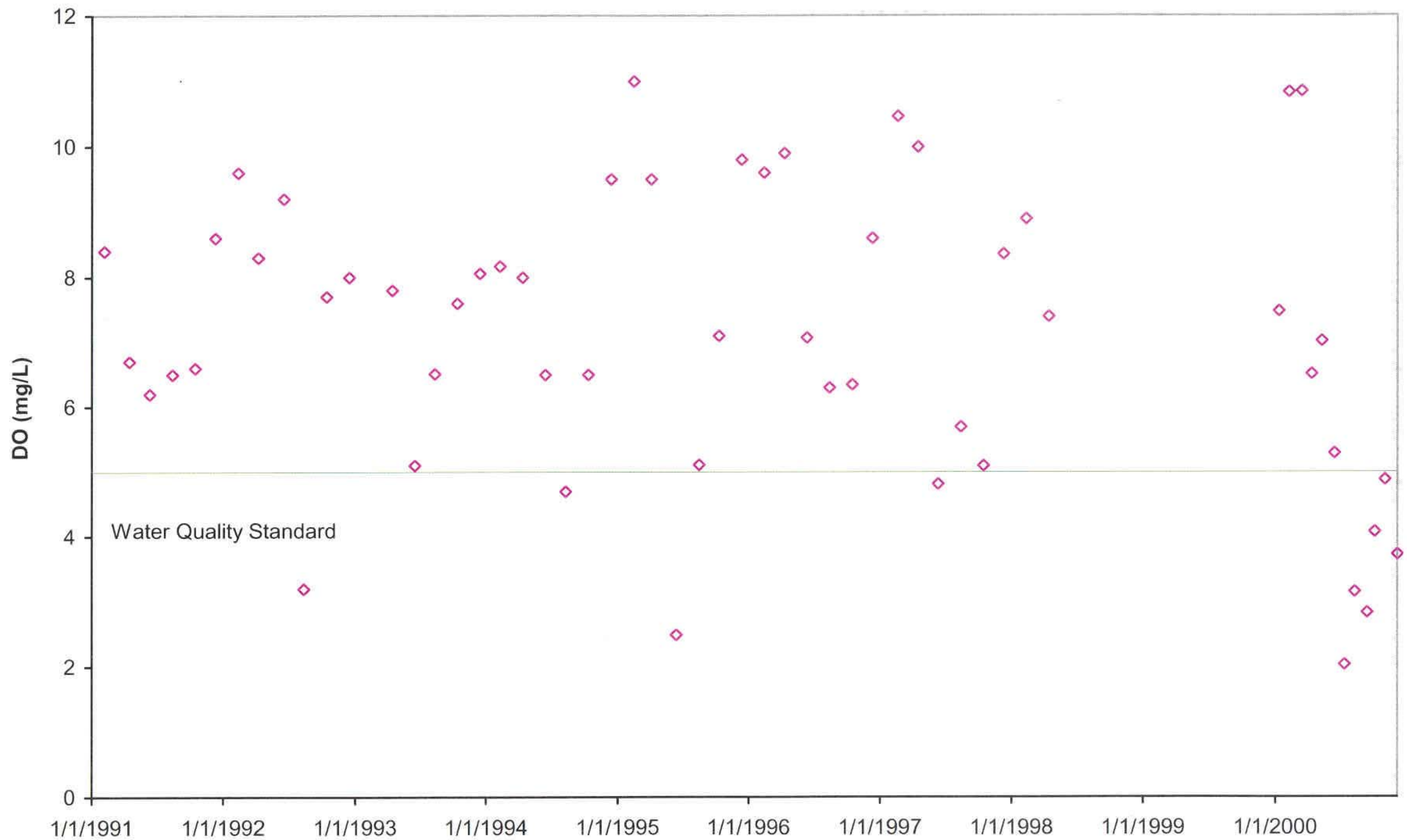

Figure 2.4. Historical water quality for Bayou des Allemands (LDEQ Station 0292).

3.0 FIELD SURVEYS

Two surveys were conducted on Bayou des Allemands by FTN personnel to obtain data needed for the model. Table 3.1 below gives a list of the sites and what data were collected at them. Figure 3.1 shows the locations of the sampling sites. Detailed documentation of data from these surveys is available in previously submitted reports (FTN 2002, FTN 2003). Both surveys were conducted about a week after significant rainfall.

Table 3.1. Summary of calibration and verification surveys.

Station Name	Data That Were Collected				
	In Situ	WQ Samples	Dye Study	Cross Section	Continuous Monitor
020201-0	A,B				
020201-1	A,B	A,B			A,B
020201-2	A,B				
020201-3	A,B	A,B			
020201-4	A,B	A,B			
020201-5	A,B				
020201-6	A,B	A,B	B*		
020201-7	A,B				
020201-8	A,B				B
020201-9	A,B				
020201-10	A,B	A,B			A
T1				A	
T2			A	A	
T3				A	
T4				A	

*Half a river kilometer downstream of station 6
A- Calibration survey (8/10/02 - 8/20/02
B- Verification survey (7/10/03)

The calibration survey was performed on August 19-20, 2002. Water quality data were gathered from a total of 11 sites. Continuous monitors were set up at two sampling sites and recorded measurements from August 19 to August 22. A dye study was performed and several stream cross-sections were taken. Data from this survey are summarized in Appendix B.

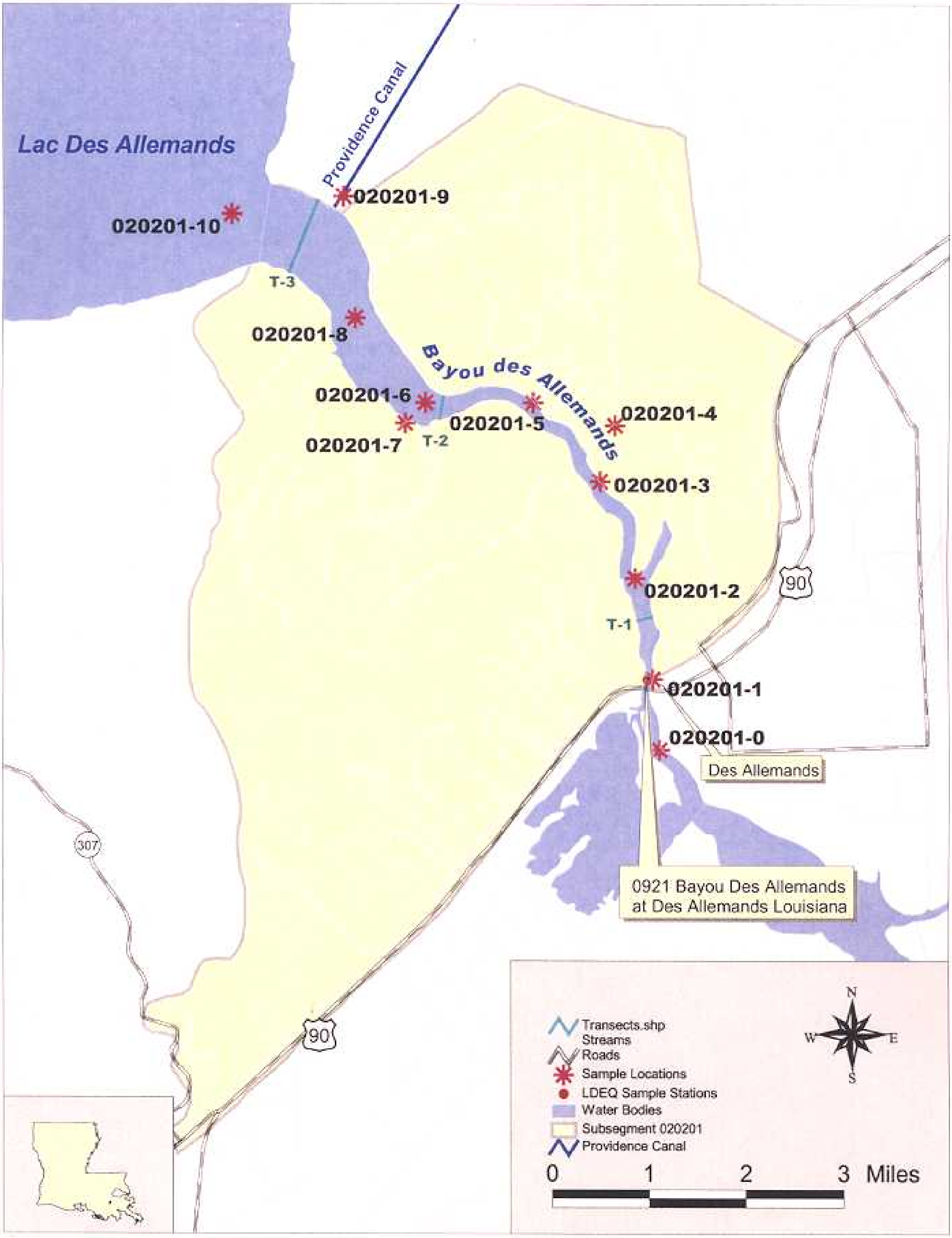

Figure 3.1. Locations for field data collection in subsegment 020201.

A second survey, the verification survey, was performed on July 10, 2003. The same sampling sites were used but no cross sections were measured. Data from this survey are summarized in Appendix C.

The water quality data for the two surveys were similar with the exception of ortho phosphorus. The calibration survey had ortho phosphorus values ranging from 0.031 to 0.089 mg/L whereas the verification survey had values ranging from 0.12 to 0.17 mg/L. However the total phosphorus concentrations were similar. In general the highest DOs and pHs occurred in the upstream portion of the bayou (which is closest to Lac des Allemands).

The 20-day CBOD time series data for each sample were input into to a LDEQ spreadsheet called GSBOD to calculate an ultimate CBOD (CBODu) and CBOD decay rate for each sample. The calculated CBODu values for each station varied between the surveys, in some cases doubling (as at station 020201-1) or quadrupling (as at station 020201-6b) from the calibration to the verification survey. For all stations the CBODu values in the verification survey were greater than the values in the calibration survey.

The continuous DO and pH data from the calibration survey showed greater diurnal variation at station 020201-10 (Lac des Allemands) than at station 020201-1 (Highway 90). This indicated higher algae productivity at station 020201-10. The continuous data from the verification survey showed similar but less pronounced trends. In this survey the pH and DO were lower at station 020201-1 (Highway 90) than at station 020201-8 (upstream of 020201-1).

The dye studies did not show any indication of reversing flows for this system during either survey.

4.0 CALIBRATION OF WATER QUALITY MODEL

4.1 Model Setup

In order to evaluate the linkage between pollutant sources and water quality, a computer simulation model was used. The model used for this TMDL was QUAL-TX (version 3.3), which was selected because it includes the relevant physical, chemical, and biological processes and it has been used successfully in the past for other TMDLs in Louisiana. The QUAL-TX model was set up to simulate organic nitrogen, ammonia nitrogen, nitrate nitrogen, ortho phosphorus, algae, ultimate carbonaceous biochemical oxygen demand (CBODu), and DO. The data used to calibrate the model were taken from the calibration survey performed on August 19-22, 2002 (see section 3.0).

The main stem of Bayou des Allemands was divided into 11 reaches corresponding to areas of different depths and widths along the stream. All of the reaches were divided into smaller elements to simulate variations in water quality within each reach.

4.2 Temperature Correction of Kinetics (Data Type 4)

The temperature correction factors used in the model were consistent with the Louisiana Technical Procedures Manual (the “LTP”; LDEQ 2003b). These correction factors were:

- Correction for BOD decay: 1.047 (value in LTP is same as model default)
- Correction for SOD: 1.065 (specified in Data Group 4)
- Correction for ammonia N decay: 1.070 (specified in Data Group 4)
- Correction for organic N decay: 1.047 (not specified in LTP; model default used)
- Correction for reaeration: automatically calculated by the model

4.3 Hydraulics (Data Types 9 and 10)

The hydraulics for each reach were specified in the input for the QUAL-TX model using the power functions (velocity = a*Q^b and depth = c*Q^d+e). Because water levels in Bayou des Allemands are controlled by tides and wind (rather than flow), it was assumed that the width and depth of each reach were independent of flow. Therefore, the exponent “b” was set to one and the exponent “d” was set equal to zero. The coefficient “a” was set equal to the inverse of the reach cross sectional area and the coefficient “c” was set equal to the inverse of the reach depth. The reach depths were based on measurements from the calibration survey, which included cross section data at four sites in the Bayou des Allemands subsegment. For reaches where cross sections were measured the depths were based on the measured depth. The depths were then varied linearly from reach to reach along the main stem. Plots of depth and width versus river kilometer are shown in Figures 4.1 and 4.2.

Because the waterbody is tidally influenced, a dispersion coefficient was included in the model input. The dispersion coefficient was calculated from the calibration survey dye study (shown in Appendix D) and the same value used for all reaches. The model inputs for the calibration are summarized in Appendix E.

4.4 Initial Conditions (Data Type 11)

Because temperature and salinity are not being simulated in the model, the temperature and salinity for each reach were specified in the initial conditions for QUAL-TX. The temperature for each reach was based on in-situ data. The salinity was calculated from the specific conductivity. The initial conditions for constituents being simulated were set equal to the calibration target values, but are only used by the model as a starting point for iteration. The inputs for chlorophyll, nitrate + nitrite, and ortho phosphorous were taken from laboratory analyses of grab samples collected during the calibration survey. The input data and sources are shown in Appendix E.

4.5 Water Quality Kinetics (Data Types 12 and 13)

Kinetic rates used in QUAL-TX include reaeration rates, CBOD decay rates, nitrification rates, mineralization rates (organic nitrogen decay), and benthic source rates for phosphorus and nitrogen. The values used as the model input are shown in Appendix E.

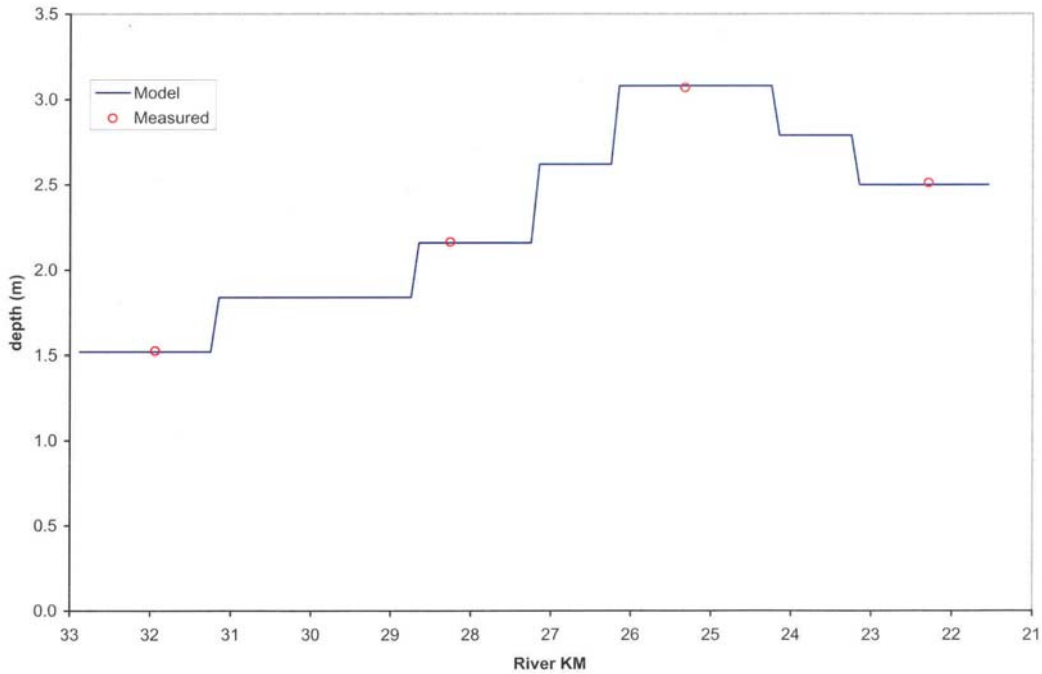

Figure 4.1. Bayou des Allemands modeled and measured depths.

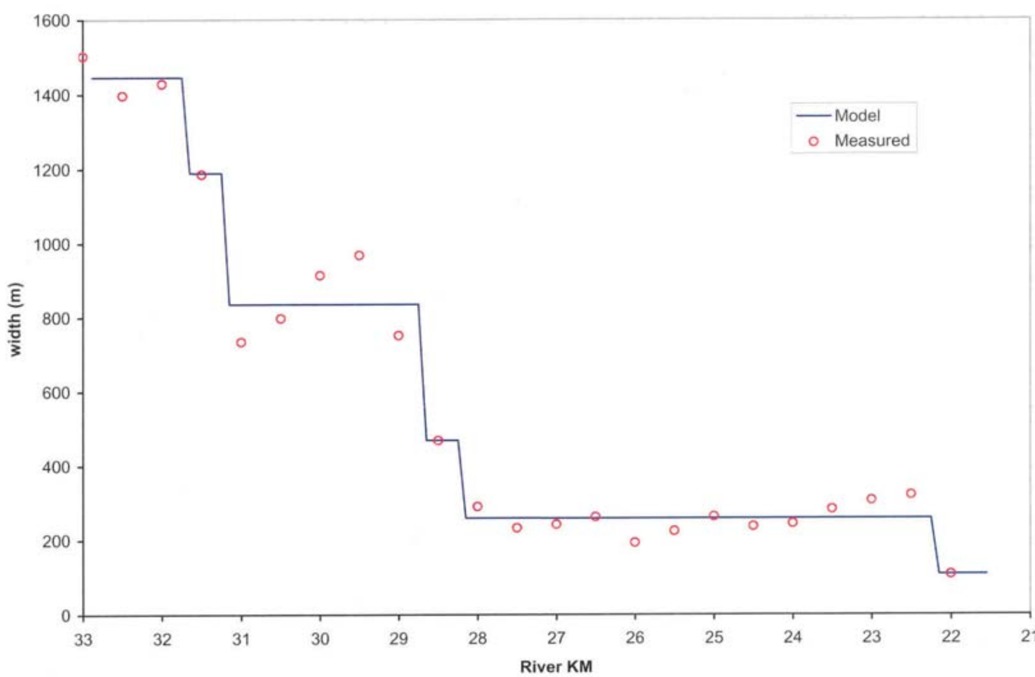

Figure 4.2. Bayou des Allemands modeled and measured widths.

For reaeration, the O'Connor Dobbins equation (option 3) was specified in the model because it was developed specifically for streams with depths and velocities similar to those found on Bayou des Allemands. A minimum surface transfer coefficient for reaeration, K_L, was calculated using wind data from New Orleans International Airport. These calculations are shown in Appendix F.

The CBOD decay rate was calculated from data collected during the calibration survey using the GSBOD spreadsheet provided by LDEQ. By putting in CBOD time series measurements for each sampling station, a CBOD decay rate was determined for each station (calculations included in Appendix B). The average of the CBOD decay rates for all the stations on Bayou des Allemands was used for all reaches in the model.

The mineralization rates (organic nitrogen decay) in the model were set to 0.02/day for all reaches. This value was similar to the values shown in Table 5.3 of the "Rates, Constants, and Kinetics" publication (EPA 1985) for dissolved organic nitrogen being transformed to ammonia nitrogen. The literature values for mineralization rates are shown in Appendix G.

Benthic source rates for phosphorus and ammonia were used for calibration. By adjusting the source rates, the amount of nutrients available to the algae for growth can be varied in order to calibrate the nutrients and algae.

4.6 Algae Coefficients (Data Types 3, 6, and 14)

Since algae was being simulated, several rates and coefficients had to be entered into the model, some of which were used for calibration. These coefficients included half saturation values for phosphorus, nitrogen, and light; solar radiation constant; rates for algal growth, settling, and respiration; algae to chlorophyll ratio; and conversion of settled algae to SOD. These inputs were held constant (i.e. did not vary by reach). The algae inputs are shown in Appendix E.

4.7 Nonpoint Source Loads (Data Types 12, 13, and 19)

The NPS loads that are specified in the model can be most easily understood as resuspended load from the bottom sediments and are modeled as SOD, benthic ammonia and phosphorus source rates, CBODu loads, and organic nitrogen loads. The SOD (specified in data type 12), the benthic ammonia and phosphorus source rates (specified in data type 13), and the mass loads of organic nitrogen and CBODu (specified in data type 19) were all treated as calibration parameters; their values were adjusted to bring the model output closer to the calibration target values.

4.8 Headwater Flow Rates (Data Type 20)

The inflow was calculated from the calibration survey dye study. The velocity from the third run of the dye study was multiplied by the average cross sectional area for the travel path of the dye to compute a volumetric flow rate (88.68 m^3/sec) just south of Providence Canal. By subtracting the calculated flow for Providence Canal (4.39 m^3/sec, see section 4.10) from this estimated flow, a headwater inflow of 84.29 m^3/sec was estimated. The dye study data can be found in Appendix B.

4.9 Headwater Water Quality (Data Type 21 and 22)

The temperature and water quality concentrations that were specified in the model for the headwater were based on data from the calibration survey in August 2002, station 020201-10. The DO was a 24 hour average of continuous monitoring data from midnight to midnight on August 20, 2002 at station 020201-10. CBODu was calculated from station 020201-10 CBOD measurements using the GSBOD spreadsheet supplied by LDEQ. Nitrate + nitrite was set to 0.05 mg/L since the measured nitrate + nitrite concentrations were below the detection limit of 0.1 mg/L. The organic nitrogen concentration was set to the measured TKN concentration minus the measured ammonia concentration.

4.10 Tributary and Wasteload Inputs (Data Types 24 and 25)

One tributary (Providence Canal) and one point source discharge (Collier's Fisheries) were included in the model. The flow for Providence Canal was calculated by averaging the velocity at three different depths taken at 020201-9 and multiplying this number by an average cross sectional area to compute a flow rate of 4.39 m^3/sec. Water quality data were obtained from the calibration survey on August 20, 2002 using station 020201-10. Station 020201-9 was on the canal itself but, had only in situ data (which were used as model inputs for this inflow). Data from 020201-10 were used for the rest of the water quality inputs for Providence Canal. An average daily DO was estimated by determining a ratio of instantaneous DO to mean DO using the nearest station that had continuous monitoring of DO. This ratio was used to convert the instantaneous DO at station 020201-9 to a daily average DO which was used as a model input (shown in Appendix H).

Flow and water quality information for Colliers Fisheries was not available in the NPDES listing for Barataria and Terrebonne prepared by EPA Region 6. Therefore, input values had to be estimated based on available information. A moderate flow of 0.01 cfs was assumed for the point source. Values for CBODu, ammonia, nitrate+nitrite, and DO were set to values in the LTP (LDEQ 2003) for effluent receiving secondary treatment using a mechanical method.

4.11 Lower Boundary Conditions (Data Type 27)

Since dispersion was being simulated, lower boundary conditions had to be included in the model. In situ data measurements from 020201-0 for temperature and specific conductivity (which was used to calculate salinity) were used for the lower boundary conditions. For all the other lower boundary condition inputs, data from station 020201-1 were used since it was the closest station with the required data.

4.12 Model Results for Calibration

Plots of predicted and observed water quality for the calibration are presented in Appendix I and a printout of the QUAL-TX output file is included as Appendix J. The calibration was considered to be acceptable based on the amount of data that were available.

5.0 VERIFICATION OF WATER QUALITY MODEL

5.1 Objective of Model Verification

After completing the calibration of the water quality model as described in Section 4, the model was verified by simulating conditions during a different time period (the verification survey) without adjusting model calibration parameters. The objective of the model verification was to evaluate how accurately the calibrated model can predict water quality for conditions other than the calibration period. The accuracy of water quality predictions for other conditions is important because the whole reason for using a model is to predict water quality for critical conditions (which are different than calibration conditions).

To achieve this objective, the verification was performed by using the calibrated model to simulate conditions from the verification survey without adjusting the calibration parameters. The only model inputs that were changed from the calibration to the verification were the initial conditions for variables not simulated (temperature and salinity) and the external boundary conditions (headwater and tributary flows and quality, downstream boundary conditions, and wind-based reaeration). Each of the inputs that was changed is discussed below; all other inputs were the same as in the calibration simulation.

5.2 Initial Conditions (Data Type 11)

Data from the verification survey were used for the initial conditions inputs. Although temperature and salinity are not being simulated in the model, the temperature and salinity for each reach was specified in the initial conditions for QUAL-TX. The temperature for each reach was based on in-situ data. The salinity was calculated from the specific conductivity. The initial conditions for DO and ammonia were set equal to the verification target values, but are only used by the model as a starting point for iteration. As with the calibration, estimated daily average DOs were computed for each station (see Section 4.10, calculations included in Appendix K). The inputs for chlorophyll, nitrate + nitrite, and ortho phosphorus were taken from laboratory analyses of grab samples. The input data and sources are shown in Appendix L.

5.3 Water Quality Kinetics (Data Types 12 and 13)

A minimum surface transfer coefficient for reaeration, K_L, was calculated using July 10, 2003 wind data from New Orleans International Airport. These calculations are shown in Appendix M.

5.4 Headwater Flow Rates (Data Type 20)

The inflow was calculated from the verification survey dye study. The velocity from the first run of the dye study was multiplied by the average cross sectional area for the travel path of the dye to compute a volumetric flowrate (106.92 m^3/sec) just south of Providence Canal. By subtracting the calculated inflow for Providence Canal (9.96 m^3/sec, see section 4.10) from this estimated flow, a headwater inflow of 96.96 m^3/sec was estimated.

5.5 Headwater Water Quality (Data Types 21 and 22)

Headwater temperature and water quality concentrations for the verification run were based on data from the FTN verification survey on July 10, 2003, station 020201-10. CBODu was calculated from CBOD measurements using the GSBOD spreadsheet supplied by LDEQ. Nitrate + nitrite was set to 0.05 mg/L since the measured nitrate + nitrite concentrations were below the detection limit of 0.1 mg/L. The organic nitrogen concentration was set to the measured TKN concentration minus the measured ammonia concentration.

5.6 Tributary and Wasteload Inputs (Data Types 24 and 25)

The flow for Providence Canal for the verification run was calculated by multiplying the velocity measured at 020201-9 by an average cross sectional area to compute a flow rate of 9.96 m^3/sec. Only insitu water quality measurements (e.g. temperature and conductivity) were collected at 020201-9 during the verification survey. Therefore, temperature and conductivity measurements from 020201-9 were used as inputs for the tributary water quality (conductivity was used to calculate salinity). Input values for the other tributary water quality parameters were taken from water quality measurements collected at 020201-10. Inputs for Colliers Fisheries were the same as in the calibration.

5.7 Lower Boundary Conditions (Data Type 27)

Lower boundary conditions for the verification run were based on data collected during the verification survey at station 020201-9 (in situ data) and station 020201-10 (laboratory analyses). No samples were collected for laboratory analyses at station 020201-9.

5.8 Model Results for Verification

Plots of predicted and observed water quality for the verification are presented in Appendix N and a printout of the QUAL-TX output file is included as Appendix O. The verification was considered to be good based on the fact that the calibration survey and the verification survey were conducted almost a year apart and two major storms (Tropical Storm Isidore and Hurricane Lilly) moved through the Barataria basin during the time between the two surveys. Storms like these that bring large amounts of rain and wind are known to have significant effects on water quality due to resuspension of bottom deposits and flushing of dissolved and particulate organic materials form marshes into bayous and lakes. Prior to performing this verification, it was anticipated that the model would poorly predict water quality for the verification due to possible changes in the benthic characteristics of the waterbody during the time between the surveys. Although the model predictions for the verification did not quite match the observed data as closely as in the calibration, the results were considered good for a "blind" verification (applying the calibrated model to a new data set without adjusting calibration parameters).

6.0 REVISED CALIBRATION OF WATER QUALITY MODEL

As discussed in Section 3.0, two surveys were conducted for this project. The model was calibrated to the calibration survey data (Section 4.0) and then run with boundary conditions from the validation survey as inputs (Section 5.0). Then, in order to develop the most accurate and robust model using all available data, the calibration was adjusted slightly to develop a single set of calibration parameter values that yielded the best match between predicted and observed data for both data sets. The adjustments to the calibration are discussed below and the revised calibration parameters are listed in Table 6.1.

First an average of CBOD decay rates for both the calibration and verification surveys was calculated. The original verification model used the CBOD decay rate from the calibration. CBOD time series data were also collected during the verification survey. These data were used to calculate an average CBOD decay rate for the verification survey (0.19/day) which was averaged with the decay rate from the calibration survey (0.09 /day) to get an overall average value of 0.14 /day. This rate was used in the revised models.

Next the ammonia source rates were decreased in several reaches to adjust the predicted ammonia concentrations. This decreased the algae concentrations which in turn led to decreased DO. To compensate for the decreased DO the SOD rates for reaches three through seven were dropped to raise the DO.

In several cases results from one model were greater than the targets in while the results from the other model were less than the targets. In some cases the magnitude of the overprediction matched the magnitude of the under prediction. The measured concentrations varied significantly between the two surveys. Both of these factors made calibrating to the two data sets difficult. The plots of the adjusted calibration and verification can be seen in Appendix P and Appendix Q, respectively. Printouts of the adjusted calibration and verification output files can be found in Appendix R and S, respectively.

Table 6.1. Adjustments to model coefficients.

Parameter	Reach(es)	Original Value	Adjusted Value
Sediment oxygen demand, $g/m^2/day$	1	0.875	1.40
	2 – 7	1.000	1.60
	8	1.110	1.80
	9	1.000	1.60
	10	0.875	1.40
	11	0.750	1.20
CBODu decay rate, Day^{-1}	1 – 11	0.09	0.14
Algae growth rate, Day^{-1}	1 – 11	0.81	1.62
CBODu mass loads kg/day	1	3840	2400
	2	2880	1800
	3	1920	1200
	4	480	300
	5 – 7	96	60
	8 – 10	240	150
	11	96	60

7.0 WATER QUALITY MODEL PROJECTION

EPA's regulations at 40 CFR 130.7 require the determination of TMDLs to take into account critical conditions for stream flow, loading, and water quality parameters. Therefore, the calibrated model was used to project water quality for critical conditions. The identification of critical conditions and the model input data used for critical conditions are discussed below.

7.1 Identification of Critical Conditions

Section 303(d) of the Federal Clean Water Act and EPA's regulations at 40 CFR 130.7 both require the consideration of seasonal variation of conditions affecting the constituent of concern and the inclusion of a MOS in the development of a TMDL. For the TMDL in this report, analyses of LDEQ long-term ambient data were used to determine critical seasonal conditions. A combination of implicit and explicit MOS was used in developing the projection model.

Critical conditions for DO have been determined for Louisiana streams in previous TMDL studies. The analyses concluded that the critical conditions for stream DO concentrations occur during periods with negligible nonpoint runoff, low stream flow, and high stream temperature.

When the rainfall runoff (and nonpoint loading) and stream flow are high, turbulence is higher due to the higher flow and the stream temperature is lowered by the cooler precipitation and runoff. In addition, runoff coefficients are higher in cooler weather due to reduced evaporation and evapotranspiration, so that the high flow periods of the year tend to be the cooler periods. DO saturation values are, of course, much higher when water temperatures are cooler, but BOD decay rates are much lower. For these reasons, periods of high loading are periods of higher reaeration and DO but not necessarily periods of high BOD decay.

LDEQ interprets this phenomenon in its TMDL modeling by assuming that the annual nonpoint loading, rather than loading for any particular day, is responsible for the accumulated benthic blanket of the stream, which is, in turn, expressed as SOD and/or resuspended BOD in the model. This accumulated loading has its greatest impact on the stream during periods of higher temperature and lower flow.

According to the LTP, critical summer conditions in DO TMDL projection modeling are simulated by using critical low flow conditions, and 90th percentile temperature for the summer season. Model loading is from perennial inflows, SOD, and resuspension of sediments.

In reality, the highest temperatures occur in July-August and the lowest stream flows may occur in other months. The combination of these conditions plus the impact of other conservative assumptions regarding rates and loadings yields an implicit MOS that is not quantified. Over and above this implicit MOS, 20% of the allowable loading for the TMDLs in this report was set aside for an explicit MOS and future growth combined.

7.2 Temperature Inputs

The LTP (LDEQ 2003b) specified that the critical temperature should be determined by calculating the 90th percentile seasonal temperature for the waterbody being modeled. Long term temperature data for Bayou des Allemands (LDEQ station 0292) were used to calculate a 90th percentile summer temperature of 30.8°C. This was used as the temperature for all reaches and boundary conditions in the model. This value is specified in Data Type 11 in the model and is shown in Appendix T. The 90th percentile temperature calculations are shown in Appendix U.

Because Bayou des Allemands has a year round standard for DO, a winter projection simulation was not performed. As discussed above, the most critical time of year for meeting a constant DO standard is the period of high temperatures and low flows (i.e., summer).

7.3 Headwater Inputs

As discussed in Section 7.1, critical hydrologic conditions for most streams are characterized by low flows. Guidance in the LTP specifies the 7Q10 or 0.1 cfs (whichever is greater) as the critical low flow for summer conditions; however, the LTP also states that for certain situations, "more appropriate critical conditions may be selected, and must be technically justified in the TMDL report." A 7Q10 value can not be calculated for Bayou des Allemands because it has frequent flow reversals due to tidal influences. Also, 0.1 cfs is not a realistic value for flow in a large stream such as Bayou des Allemands.

For tidal channels with flows greater than 100 cfs, the LDEQ water quality standards specify a critical flow that is calculated as "1/3 of the average or typical flow over one tidal cycle irrespective of flow direction" (LAC 33:IX.1115.C.7). Therefore, the critical flow for the projection simulation in this report was calculated as 1/3 of the average tidal flow using data from an LDEQ field study on Bayou des Allemands during September 2002 . Absolute values of the flow were averaged over a 72 hour period and then divided by 3 to obtain a critical flow value of 26.8 m3/sec, which was input to the model as the headwater flow rate. These calculations are shown in Appendix V.

As specified in the LTP, the DO concentration for the headwater inflow was set to 90% saturation at the critical temperature. Headwater concentrations for other parameters were kept at the calibration values.

7.4 Tributary and Wasteload Inputs

The inflow for Providence Canal was set to zero for the projection because it was assumed to have negligible flow during critical low flow conditions. The flow for Collier's Fisheries was increased by 20% to account for potential future growth. Water quality inputs were the same as for the calibration. The values used as wasteload inputs for the projection simulation are shown in Appendix T.

7.5 Nonpoint Source Loads

Because the initial projection simulation showed low DO values, the NPS loadings were reduced until all of the predicted DO values were equal to or greater than the water quality standard of 5.0 mg/L. The same percent reduction was applied to all components of the NPS loads (SOD, benthic ammonia and phosphorus source rates, and mass loads of CBODu). The values used as model input in the projection simulation are shown in Appendix T.

7.6 Reaeration

For the projection, the minimum surface transfer coefficient for reaeration (K_L) was calculated based on long term average wind speeds rather than the wind speed during the intensive survey. Long term average wind speeds for each month of the year for New Orleans were examined and the lowest value within the summer season (May through October) was used to calculate the minimum K_L value. These calculations are shown in Appendix W.

7.7 Other Inputs

The only model inputs that were changed from the adjusted calibration to the projection simulation were the inputs discussed above in Sections 7.2 through 7.6. Other model inputs (e.g., hydraulic and dispersion coefficients, decay rates, reaeration equations, algal coefficients, etc.) were unchanged from the calibration simulation.

7.8 Model Results for Projection

A plot of predicted DO for the projection is presented in Appendix X and a printout of the QUAL-TX output file is included as Appendix Y.

A NPS load reduction of approximately 75% was required to bring the predicted DO values to at least 5.0 mg/L. This percentage reduction for NPS loads represents a percentage of the entire NPS loading, not a percentage of the manmade NPS loading. The NPS loads in this report were not divided between natural and manmade because it would be difficult to estimate natural NPS loads for the study area. There are no LDEQ reference streams in the Barataria basin.

Oxygen demand from point sources in this subsegment was very small; therefore, the modeling assumed no changes to existing permit limits for point source discharges.

8.0 TMDL CALCULATIONS

8.1 DO and Nutrient TMDLs

Total maximum daily loads (TMDLs) for DO and nutrients were calculated for the Bayou des Allemands subsegment based on the results of the projection simulation. The TMDLs are presented as allowable loads of CBODu, organic nitrogen, ammonia nitrogen, nitrite+nitrate nitrogen, and phosphorus. The TMDL calculations were performed using an Excel spreadsheet developed by FTN personnel (shown in Appendix Z). A summary of the loads for Bayou des Allemands is presented in Table 8.1.

Table 8.1. DO and nutrient TMDLs for subsegment 020201 (Bayou des Allemands).

	Loads (kg/day)				
	CBODu	Organic N	Ammonia N	NO2+NO3 N	Phosphorus
Point source wasteload allocation (WLA)	2.86	0.21	0.42	0.42	0.21
Nonpoint source load allocation (LA)	8298.66	2926.82	348.97	92.62	258.94
Explicit Margin of Safety (10%)	1037.69	365.88	43.67	11.63	32.40
Future Growth (10%)	1037.69	365.87	43.67	11.63	32.39
Total maximum daily load (TMDL)	10376.90	3658.78	436.73	116.30	323.94

8.2 Recommendations for NPS and Point Source Loads

In summary, the projection modeling used to develop the TMDLs above showed that NPS loads need to be reduced by 75% to maintain the DO standard in Bayou des Allemands under critical conditions.

Because oxygen demand from point sources in this subsegment was very small; the modeling assumed no changes to existing permit limits for point source discharges. The nonconservative behavior of dissolved oxygen allows many small to remote point source dischargers to be assimilated by their receiving waterbodies before they reach the modeled waterbody. These dischargers are said to have very little to no impact on the modeled waterbody and therefore, they are not included in the model and are not subject to any reductions based on this TMDL. These facilities are permitted in accordance with state regulation and policies that provide adequate protective controls. New similarly insignificant point sources will continue to be issued permits in this manner. Significant existing point source dischargers are either included in the TMDL model or are determined to be insignificant by other modeling. New significant point source dischargers would have to be evaluated individually to determine what impact they have on the impaired waterbody and the appropriate controls.

Although the nutrient TMDL includes a WLA for phosphorus, it is recommended that as a first step to implement this TMDL, the point sources should be given monitoring requirements in their permits to determine if phosphorus effluent limitations are appropriate.

8.3 Increased Inflows From Diversions

Much of coastal Louisiana was built by the process of delta formation through flooding and deposition of sediments by the rise and fall of the Mississippi River. Based on EPA's present knowledge, extensive areas of wetlands and coastal marshes are affected by a high rate of subsidence and degradation, primarily due to a lack of historical sediment and nutrients entering the wetlands. Subsidence is a natural process, but the building of levee systems has restricted the Mississippi River's course therefore preventing the natural cycle of the river and the natural process of delta formation. According to EPA, a large portion of the state's coastal wetlands have undergone and continue to undergo a severe deprivation of sediments and nutrients that has led quite literally to the breakup of the natural system. In addition, EPA believes that many of Louisiana's wetlands have become isolated from the riverine sources that created them and are becoming stagnant and starved for nutrients and organic and inorganic sediments. It should be pointed out that restoration of these eroding wetlands involves supplying nutrients to these wetlands through managed Mississippi River diversions.

The TMDLs in this report for DO and nutrients for Bayou des Allemands do not include any known diversion projects from the Mississippi River or other tributaries at this time. However, any future reintroduction under the Louisiana Coastal Area Restoration projects could increase the flow in Bayou des Allemands. EPA believes that flows greater than the critical flows used in the TMDLs will enhance DO and decrease the likelihood of instream nutrient impairment in Bayou des Allemands. Based on EPA's understanding, if any future diversion from the

Mississippi River or other tributaries into Bayou Des Allemands increases flow, the nonpoint source load allocation and TMDL will also be increased proportionately.

Based on EPA's current understanding, the diversion projects are supported by both State and Federal agencies, including EPA and the U.S. Army Corps of Engineers. The diversions are managed by the Corps of Engineers and the State, and the projects include post-diversion monitoring to determine effectiveness of the project and to monitor water quality conditions.

8.4 Seasonal Variation

As discussed in Section 7.1, critical conditions for DO in Louisiana waterbodies have been determined to be when there is negligible nonpoint runoff and low stream flow combined with high water temperatures. In addition, the model accounts for loadings that occur at higher flows by modeling sediment oxygen demand. Oxygen demanding pollutants that enter the waterbodies during higher flows settle to the bottom and then exert the greatest oxygen demand during the high temperature seasons.

8.5 Margin of Safety

The MOS accounts for any lack of knowledge or uncertainty concerning the relationship between load allocations and water quality. As discussed in Section 7.1, the highest temperatures occur in July through August and the lowest stream flows may occur in other months. The combination of these conditions, in addition to other conservative assumptions regarding rates and loadings, yields an implicit MOS which is not quantified. In addition to the implicit MOS, the TMDLs in this report set aside 20% of the allowable loading for the explicit MOS and future growth component combined.

8.6 Ammonia Toxicity Calculations

Although subsegment 020201 is not on a 303(d) List for ammonia, the ammonia concentrations predicted by the projection model were checked to make sure that they did not exceed EPA criteria for ammonia toxicity (EPA 1999). The EPA criteria are dependent on temperature and pH. The water temperature used to calculate the ammonia toxicity criterion for

Bayou des Allemands was the same as the critical temperature used in the projection simulation (30.8ºC). For pH, an average of the values measured at the LDEQ stations during the calibration period was used. The resulting criterion was 1.51 mg/L of ammonia nitrogen. The instream ammonia nitrogen concentrations predicted by the QUAL-TX model (0.12 – 0.33 mg/L) were well below the criterion. This indicates that the ammonia nitrogen loadings that will maintain the DO standard are low enough that the EPA ammonia toxicity criteria will not be exceeded under critical conditions. The ammonia toxicity calculations are shown in Appendix AA.

9.0 SENSITIVITY ANALYSIS

All modeling studies necessarily involve uncertainty and some degree of approximation. It is therefore of value to consider the sensitivity of the model output to changes in model coefficients, and in the hypothesized relationships among the parameters of the model. The sensitivity analyses were performed by allowing the QUAL-TX model to vary one input parameter at a time while holding all other parameters to their original value. The revised calibration simulation was used as the baseline for the sensitivity analysis. The percent change of the model's minimum DO projections to each parameter is presented in Table 9.1. Each parameter was varied by ±30%, except for temperature, which was varied ±2ºC.

Values reported in Table 9.1 are sorted by percentage variation of minimum DO from smallest percentage variation to largest. The predicted DO was most sensitive to SOD, algae growth, and headwater DO, and it was least sensitive to lower boundary inputs and tributary/wasteload inputs.

Table 9.1. Summary of results of sensitivity analysis.

Input parameter	Predicted minimum DO (mg/L) with input parameter changed by:		Average percent change in DO
	-30%	+30%	
Baseline simulation (no change)	4.00		--
SOD	5.27	2.71	32.0%
Algae Growth	2.79	4.84	25.6%
Headwater DO	3.09	4.87	22.3%
Headwater Flow	3.26	4.52	15.8%
Velocity	3.33	4.49	14.5%
Algae Settling	4.55	3.50	13.1%
Temperature	4.38	3.59	9.9%
Reaeration	3.57	4.34	9.6%
NH3 Benthic Source	3.60	4.31	8.9%
Algae Respiration	4.34	3.65	8.6%
BOD Decay	4.23	3.79	5.5%
Headwater BOD	4.19	3.80	4.9%
Headwater NH3-N	3.80	4.19	4.9%
Headwater NO3-N	3.91	4.08	2.1%
Headwater PO4	3.92	4.04	1.5%
Depth	4.03	3.97	0.8%
Tributary/Wasteload DO	3.97	4.03	0.8%
Lower Boundary DO	3.94	4.00	0.8%
NH3 Decay	4.01	3.98	0.4%
Tributary/Wasteload Flow	3.99	4.01	0.2%
Tributary/Wasteload BOD	4.01	3.99	0.2%
Tributary/Wasteload NH3-N	3.99	4.01	0.2%
Tributary/Wasteload Chlorophyll a	4.00	3.99	0.1%
Tributary/Wasteload NO3-N	3.99	4.00	0.1%
Tributary/Wasteload PO4	3.99	4.00	0.1%
Dispersion	4.00	4.00	0.0%
PO4 Benthic Source	4.00	4.00	0.0%
Lower Boundary BOD	4.00	4.00	0.0%
Lower Boundary Chlorophyll a	4.00	4.00	0.0%
Lower Boundary NH3-N	4.00	4.00	0.0%
Lower Boundary NO3-N	4.00	4.00	0.0%
Lower Boundary PO4	4.00	4.00	0.0%

10.0 OTHER RELEVANT INFORMATION

This TMDL has been developed to be consistent with the antidegradation policy in the LDEQ water quality standards (LAC 33:1X.1109.A).

Although not required by this TMDL, LDEQ utilizes funds under Section 106 of the Federal Clean Water Act and under the authority of the Louisiana Environmental Quality Act to operate an established program for monitoring the quality of the state's surface waters. The LDEQ Surveillance Section collects surface water samples at various locations, utilizing appropriate sampling methods and procedures for ensuring the quality of the data collected. The objectives of the surface water monitoring program are to determine the quality of the state's surface waters, to develop a long-term data base for water quality trend analysis, and to monitor the effectiveness of pollution controls. The data obtained through the surface water monitoring program is used to develop the state's biennial 305(b) report (Water Quality Inventory) and the 303(d) List of impaired waters. This information is also utilized in establishing priorities for the LDEQ NPS program.

The LDEQ has implemented a watershed approach to surface water quality monitoring. Through this approach, the entire state is sampled over a four-year cycle. Long-term trend monitoring sites at various locations on the larger rivers and Lake Pontchartrain are sampled throughout the four-year cycle. Sampling is conducted on a monthly basis to yield approximately 12 samples per site each year the site is monitored. Sampling sites are located where they are considered to be representative of the waterbody. Under the current monitoring schedule, approximately one half of the state's waters are newly assessed for 305(b) and 303(d) listing purposes for each biennial cycle with sampling occurring statewide each year. The four-year cycle follows an initial five-year rotation which covered all basins in the state according to the TMDL priorities. This will allow the LDEQ to determine whether there has been any improvement in water quality following implementation of the TMDLs. As the monitoring results are evaluated at the end of each year, waterbodies may be added to or removed from the 303(d) list.

11.0 PUBLIC PARTICIPATION

When EPA establishes a TMDL, 40 CFR §130.7(d)(2) requires EPA to notify the public and seek comment concerning the TMDL. Pursuant to an October 1, 1999 Court Order, these TMDLs were prepared under contract to EPA. After development of these TMDLs, EPA issued a notice seeking comments, information, and data from the general and affected public. Comments were submitted by four organizations during the public comment period, and these TMDLs have been revised accordingly. Responses to these comments are included in Appendix AB. EPA has transmitted the revised TMDLs to LDEQ for implementation and incorporation into LDEQ's current water quality management plan.

12.0 REFERENCES

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APPENDICES A THROUGH AA ARE AVAILABLE FROM EPA UPON REQUEST

APPENDIX AB

Responses to Public Comments

COMMENTS AND RESPONSES
BAYOU DES ALLEMANDS TMDLs FOR DO AND NUTRIENTS
March 25, 2005

EPA appreciates all comments concerning these TMDLs. Comments that were received are shown below with EPA responses or notes inserted in a different font.

COMMENTS FROM LOUISIANA DEPARTMENT OF ENVIRONMENTAL QUALITY (LDEQ):

1. Page i - Executive Summary: The first paragraph states, "This report presents a TMDL that has been developed for dissolved oxygen (DO) for Bayou des Allemands (subsegment 020201) in the Ouachita River Basin in northern Louisiana. This paragraph should be revised to list the correct subsegment, basin, and geographic location.

`Response: These corrections have been made.`

2. Page 2-5 - 2.3 Point Sources: A list of the dischargers should be included in the report. The list should indicate if the facility was modeled or just included in the TMDL. The list should also indicate the permit limits as a result of this TMDL. Any resulting permit limits should be presented in the Executive Summary and section 7.8 Model Results for Projection.

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Response: The point source list in Appendix A indicates which
          facilities were modeled, which ones were included in the
          TMDLs, and the effluent concentrations that were simulated
          in the model (which were set equal to permit limits).  As
          stated in the body of the report, the modeling and TMDLs
          assume no changes to current permit limits for point source
          discharges.
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3. Page 8-1 – 8.0 TMDL Calculations: This section should include discussion concerning how small dischargers should be allocated. An example used by LDEQ is as follows:

"The nonconservative behavior of dissolved oxygen allows many small to remote point source dischargers to be assimilated by their receiving waterbodies before they reach the modeled waterbody. These dischargers are said to have very little to no impact on the modeled waterbody and therefore, they are not included in the model and are not subject to any reductions based on this TMDL. These facilities are permitted in accordance with state regulation and policies that provide adequate protective controls. New similarly insignificant point sources will continue to be issued permits in this manner. Significant existing point source dischargers are either included in the TMDL model or are determined to be insignificant by other modeling. New significant point source dischargers would have to be evaluated individually to determine what impact they have on the impaired waterbody and the appropriate controls."

Response: This text has been added to Section 8.2 of the report.

4. <u>8.5 Ammonia Toxicity Concerns:</u> Since this waterbody was not listed on the 303(d) list for ammonia, this discussion is unnecessary and should be deleted from the report.

Response: Ammonia toxicity calculations were performed to ensure that the ammonia loadings that will maintain DO standards will not cause any exceedences of the ammonia toxicity criteria. National guidance for ammonia toxicity was used in the absence of any numerical state water quality standards for ammonia. EPA believes this evaluation offers assurances that waters will continue to be free from the effects of toxic substances.

5. <u>8.5 Ammonia Toxicity Concerns:</u> 4th Line, delete Ouachita River.

Response: This correction has been made.

6. <u>Page 9-1 – 9.0 Other Relevant Information:</u> This section should be updated to include the new 4-year sampling cycle.

Response: Section 9.0 describes LDEQ's 4-year sampling cycle.

7. <u>Dissolved Oxygen / Reaeration:</u> It is stated, "the long term average wind speeds for each month of the year for New Orleans were examined and the lowest values within each season were used to calculate the minimum KL values". A more representative approach would have been to use a seasonal average for each season. DEQ does not use extreme limits for input values for any of the modeling parameters.

Response: Section 303(d) of the Clean Water Act and federal regulations at 40 CFR 130.7 both require TMDLs to account for critical conditions. Using a wind speed that is averaged over a month is not considered extreme, and is consistent with using the 90th percentile temperature and critical low flows.

8. <u>BOD Calculations:</u> Total BOD was calculated using a 20-day cycle. It is the general practice of LDEQ to use a 60 cycle.

Response: Resources were not available for 60 day BOD measurements. Use of 20 day BOD data is widely accepted for TMDLs and is considered appropriate for these TMDLs.

9. <u>BOD Calculations:</u> The CBOD values calculated using the BOD Analysis spreadsheet were overestimated due to the fact that NO2+NO3 data values were not used. The resulting ultimate CBOD values were actually the total ultimate BOD values. At the same time, the nitrogen series was also being simulated. In effect, the nitrogen was expressed in two different parameters.

Response: The CBOD values were calculated from the spreadsheet using CBOD values measured in a lab with a nitrogen inhibitor present in the samples. Therefore, the BOD in the model was truly CBOD, and nitrogenous oxygen demand was simulated only through nitrification of ammonia.

10. <u>BOD Calculations:</u> Settling rates were not used in the model. The effect of settling on dissolved oxygen was simulated by SOD. This is not the general practice of LDEQ.

Response: No available information indicated the necessity for including settling rates for BOD. However, settling was simulated for algae.

11. <u>BOD Calculations:</u> Modified decay rates for CBOD were used rather than the bottle rates due to the fact that the samples "were seeded". This is not the general practice of LDEQ. However, average values may be used for reaches with similar water quality.

Response: For the Bayou des Allemands model, the laboratory CBOD decay rates were averaged over multiple stations but not modified due to seeding of the samples. This comment appears to be based on the Lake Cataouatche model rather than the Bayou des Allemands model.

12. <u>BOD Calculations:</u> Bottle decay rates were apparently not calculated for Organic Nitrogen. This is not the general practice of LDEQ.

Response: For most TMDLs, organic nitrogen decay rates are not determined from laboratory data. The use of a reasonable decay rate from published literature was considered appropriate for these TMDLs.

13. <u>Vector Diagram:</u> A vector diagram should be presented in the report.

Response: A vector diagram was not considered necessary because the Bayou des Allemands model consists of one main stem with no branches.

14. <u>Calibration, Verification, Recalibration, and Projection Graphs:</u> Calibration, verification, and recalibration graphs for dissolved oxygen, CBODU, orthophosporus, and the nitrogen series should be presented in the body of the report.

Response: These graphs can be viewed in the Appendices. There are no requirements for placing graphs in the body of the report.

15. <u>Calibration, Verification, Recalibration, and Projection Graphs:</u> Projection graphs for dissolved oxygen should be presented in the body of the report.

Response: These graphs can be viewed in the Appendices. There are no requirements for placing graphs in the body of the report.

16. <u>Winter Projection:</u> A winter projection should have been performed. LDEQ issues permits based on seasonality.

Response: As discussed in Section 7.1 of the report, summer is the most critical season for meeting the year round standard for DO for this subsegment. Therefore, the summer simulation satisfies the seasonality requirements of the Clean Water Act. The available information for point source discharges indicated that the facilities discharging to this subsegment do not have seasonal permit limits. If any of these facilities wishes to pursue seasonal permit limits, then LDEQ or the permittee can re-run the model to develop seasonal wasteload allocations.

COMMENTS FROM THE GULF RESTORATION NETWORK (GRN):

1. <u>Lack of Implementation Plan and Reasonable Assurances:</u> There is no implementation plan described in these TMDLs at all. I was unable to find any indication of how the necessary reductions in nonpoint source pollution will be obtained. According to EPA guidance, waters impaired primarily by nonpoint sources require a description of its plan for reducing load allocations. Not only do these TMDLs not describe specific BMPs that will be used to achieve the prescribed manmade nonpoint source reductions, there is also no indication of a timeframe for implementation.

Response: Current federal regulations and guidance do not require TMDLs to include implementation plans. The TMDLs in this report do not include implementation plan components, such as descriptions of specific BMPs for reducing nonpoint source oxygen demand or timeframes for implementing BMPs. Although it is EPA’s desire for implementation plans to be developed and carried out these TMDLs, time and money were not available to develop implementation plans.

2. <u>Lack of Implementation Plan and Reasonable Assurances:</u> According to EPA guidance, a TMDL can only rely on nonpoint source reductions if reasonable assurances that the nonpoint source load allocations will be achieved are provided. In these TMDLs, there are no reasonable assurances that the 75% nonpoint source reductions for Bayou Des Allemands and 60% nonpoint reductions reductions for Bayou Verret will be achieved.

Response: EPA guidance for TMDLs requires assurances of nonpoint source reductions ONLY when point sources are given less stringent WLAs based on assumptions that nonpoint source loads will actually be reduced. The point source discharges in this subsegment represented an insignificant fraction of the total oxygen demand and their WLAs were not contingent upon any reductions of nonpoint source loads.

3. <u>Narrative Nutrient Criteria Missing from Bayou Des Allemands TMDL:</u> I was unable to find any reference to Louisiana's narrative nutrient criteria in the Bayou Des Allemands TMDL. This seems unusual considering that the TMDL was developed for both dissolved oxygen and nutrients, and the narrative criteria were included in the Lake Cataouatche and Tributaries TMDL. Therefore, we request that this information also be added to the Bayou Des Allemands TMDL.

Response: A description of Louisiana's narrative nutrient criteria has been added to Section 2.2 of the report.

COMMENTS FROM LOUISIANA STATE UNIVERSITY AGRICULTURAL CENTER:

1. Area land use is listed at: 54.8% fresh water marsh; 24.2% wetland forest; 11.9 % water; 5.8% agricultural; and 0.4% urban and the TMDL calls for a 75% reduction in NPS loadings to reach a DO Standard of 5 mg/L. This low DO is clearly a natural condition as total elimination of all loadings from the small percentage of the land area affected by man could not reach one third of the required reductions. The DO standard needs to be revised and lowered to one appropriate for this type system and topography.

Response: In accordance with federal regulations, these TMDLs were developed based on allowable loadings to maintain the existing DO standard (5 mg/L). Even though this subsegment has large percentages of marsh and forest, it is still affected by human alterations to the environment, particularly hydromodification (e.g., lack of inflow of Mississippi River water that is now controlled by levees, dredging of numerous canals and channels, etc.). If LDEQ changes the standards for this subsegment, then these TMDLs can be revised accordingly.

2. All of the data used in making the TMDL determinations are in Appendices which were not available. The Table of Sensitivities used in evaluating the model and showing the most important factors apparently was not done as it is not included and not listed as an Appendix.

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Response: All appendices are available (in hard copy format) from EPA
          upon request.  A sensitivity analysis has been added to the
          report.
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3. Again, we request that all of the DO standards for Louisiana streams in low profile areas be reexamined and set at appropriate levels and not an arbitrary numeric standard of 5 mg/l.

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Response: As mentioned above, TMDLs must be developed based on
          existing standards.  If LDEQ changes the standards for this
          subsegment, then these TMDLs can be revised accordingly.
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COMMENTS FROM BARATARIA TERREBONNE NATIONAL ESTUARINE PROGRAM (BTNEP):

1. The Barataria-Terrebonne National Estuary Program (BTNEP) requests an extension of the comment period for the TMDL for Bayou des Allemands and Lake Cataouatche noticed in the December 1, 2004 Federal register (Volume 69, Number 230). This TMDL was prepared by a contractor for Region 6 EPA. BTNEP will require more time for a thorough review of these TMDLs and for preparation of comments. With the holidays of this month, a 30 day comment period is insufficient as many staff were out of the office. BTNEP would like to thoroughly review this draft of the TMDL. Therefore, we respectfully request that you extend the comment period for an additional 30 days through February 2, 2005.

BTNEP also requests that EPA Region 6 notify the plaintiffs in the TMDL lawsuit of the need to extend the comment period and to request an extension of the consent decree deadline for the completion of the Barataria Basin TMDLs

The BTNEP is very concerned about the potential impacts that TMDLs for nutrients and sediment may have on Louisiana's coastal restoration efforts. The BTNEP is intimately involved in coastal restoration efforts and represents a partnership of 42 public and private agency partners in the effort for coastal and estuarine restoration. Although we do not speak for each agency partner, we have serious concerns about the effect that TMDLs may have on current and future coastal restoration efforts.

We are very concerned that if the TMDLs are enforced on the river diversion projects that are currently being designed to mimic the historical, natural freshwater inputs, they could limit the amount of Mississippi River water used for restoration in the Barataria Basin due to limitations on the sediment and nutrients in river water. The BTNEP Management Conference considers the re-establishment of natural riverine inputs to be one of our most valuable restoration tools. We believe that a significant limitation placed on our ability to divert reasonable amounts of Mississippi River water into the Barataria Basin for wetlands restoration purposes could seriously compromise our efforts

Response: Text has been added to the Executive Summary and to Section 8 of the report explaining that EPA believes that restoration of these coastal wetlands involves supplying nutrients through managed Mississippi River diversions. The report also states that low flow was determined to be the critical condition for these TMDLs. Although there are no current diversions of Mississippi River water into Bayou des Allemands, modeling results from this project indicate that if Mississippi River water was diverted into Bayou des Allemands, it should not cause any detrimental effects to DO concentrations in Bayou des Allemands. Therefore, these TMDLs are not intended to limit future diversions of Mississippi River water for coastal restoration.